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ABSTRACT

In this study, selected aspects of the college environment were related to student academic achievement at 27 small liberal arts colleges. The colleges' social and academic environment were assessed through students' perceptions and included five scales describing the extent of faculty-student interaction, student activism, curriculum flexibility, academic challenge, and the colleges' cultural facilities. Results suggest that certain student-described college environmental features are related to academic achievement, although replication with another group of colleges would be desirable. (Author/AG)

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COLLEGE ENVIRONMENTS AND STUDENT ACADEMIC ACHIEVEMENT

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John A. Centra and Donald Rock

Abstract

In this study, selected aspects of the college environment were related to student academic achievement at 27 small liberal arts colleges. Academic achievement was measured by senior students' scores on the Area Tests of the Graduate Record Examination; the Scholastic Aptitude Test (Verbal and Mathematics) scores of these same students prior to college entrance were used as a control measure for differences in initial aptitude. The colleges' social and academic environment were assessed through students' perceptions and included five scales describing the extent of faculty-student interaction, student activism, curriculum flexibility, academic challenge, and the colleges' cultural facilities. All but the Activism scale were related to student over or underachievement on one or more of the three Area Tests (Humanities, Natural Science, Social Science). In particular, students at colleges with high scores on the Faculty-Student Interaction scale more often overachieved on two of the criteria tests, while students at colleges with low scores on this scale underachieved on all three of the tests. The results suggest that certain student-described college environmental features are related to academic achievement, although replication with another group of colleges would be desirable.

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John A. Centra and Donald Rock

The voluminous research dealing with the impact of different colleges on their students has been recently reviewed by Feldman and Newcomb (1969). The vast majority of past studies have dealt with the affective domain, with Feldman and Newcomb concluding in general terms that "Freshman-to-senior changes in several characteristics have been occurring with considerable uniformity in most American colleges and universities, in recent decades" (p. 326).

While knowledge of changes in students' values and attitudes are undoubtedly important, student cognitive growth is also a critical goal of higher education. Recent multicollege studies by Nichols (1964) and by Astin (1968) have found little relationship between student academic achievement and various objective institutional measures. Controlling for academic ability prior to college and using these same students' scores on the Graduate Record Examination Area Tests as the criteria, Astin (1968) concluded that such institutional resources as the ratio of library books to students, the proportion of faculty with a doctorate, and college income per student contributed little to student achievement. Rock, Centra, and Linn (1970) conducted a similar study with a larger group of students and colleges, and found, as with the Astin study, that a high proportion of the differences between colleges in senior students' academic achievement (output) was predictable from these same students' academic aptitude at entrance to college (input). The Rock, Centra, and Linn study concluded, however, that college income per student and the porportion of faculty with doctorates did, to some extent, distinguish high achieving groups of colleges from low achieving groups.

While indices of institutional resources or quality such as college income per student are important, it is difficult to argue that these measures per se produce differential achievement among colleges. More likely, they are related to other features of the college environment that more directly influence student learning. It would seem then that studies, which identify college environmental features related to the amount of learning that takes place, are needed; assuming that these environmental features could be altered, colleges could make the kinds of changes that would result in greater student academic achievement. The purpose of this study was to investigate selected features of the college environment presumed to be related to students achieving significantly more or less than one would predict from their aptitude at entrance.

Method

The analysis in this study consisted of first identifying those groups of college seniors who achieved significantly better or worse than predicted from their input or freshmen aptitude scores and, secondly, identifying features of the college environment which discriminated between these overachieving students and underachieving students. Input or predictor information included the students' Scholastic Aptitude Test Verbal (SAT-V) and Mathematics (SAT-M) scores, which were obtained at time of entrance to college, and the students' major field of study in college. The output or performance variables consisted, as in earlier studies, of students' scores on GRE Social Science, Natural Science and Humanities Area Tests. These tests assess the student's grasp of basic concepts in these three broad areas; to the extent that the purposes of a college education include the kind of general knowledge and grasp of basic concepts

stressed by the Area Tests, they may be considered appropriate output measures for this study.

The students' major field of study was used as a predictor for the Area Test most appropriate to that major, while SAT-V and SAT-M were both used as predictors for all three Area Tests.

The college environmental measures were based on student responses to the "Questionnaire on Student and College Characteristics" (QSCC), an instrument developed in 1968 for the purpose of gathering information about both the characteristics of students attending a particular college and the college's social and academic climate (Centra, 1968). There are 77 items in the QSCC that elicit students' perceptions of their college. (E.g., Faculty members tend to be aloof and somewhat formal with students.) Mean student responses on each of the 77 items for each of 214 institutions were factor analyzed, resulting in eight rotated factors (Centra, 1970). Five of the eight factors were used in the present study:

Faculty-Student Interaction -- The extent to which students feel that the faculty are interested in teaching and in students as individuals.

Activism -- The degree of student concern for political, economic, and social issues; students involve themselves in controversial issues.

Curriculum Flexibility -- The degree to which students have freedom in choosing courses and can experiment before selecting a major.

Unchallenging -- A campus where students do not feel challenged in their course work and where they are more concerned about social life than about academic or intellectual matters. Students give poor ratings to the library and bookstores.

Cultural Facilities -- The degree to which students view their college's cultural program and facilities as excellent.

The three other factors, referred to as Restrictiveness, Non-Academic Emphasis, and Laboratory Facilities, were omitted in this study because they

either correlated highly (about .60) with one of the other factors or were not expected to be related to achievement. Moreover, the moderated regression technique, which was used in this study, is limited to five variables.

Statistical Procedure

The college environmental scales associated with students who tend to over- and/or underachieve were identified through the moderated regression technique (Rock, Barone, & Linn, 1967). This technique groups individuals according to their similarity on selected characteristics in order to identify homogeneous groups of students for which the overall regression equation results in overprediction or in underprediction. That is, this method requires that the investigator hypothesize a number of variables (up to five) that may, either singly or in combination, have a moderating influence on the relationship between a criterion and one or more predictor variables. In this study the moderated regression technique compares the mean GRE Area Test average that has been predicted and the mean GRE Area Test average that had actually been obtained for any particular group of individuals. Subtraction of the predicted values from the obtained values yields a mean residual which is an index of the amount of overprediction (a negative residual) or underprediction (a positive residual) which characterizes that particular group.

This function, then, determines the groups between which there is the largest absolute difference in mean residual values. Hopefully this will result in a system of subgroups, two of which are of particular interest: one that is characterized by overachievement, the other by underachievement. These groups can then be described in terms of their characteristics on the grouping variables or moderators which in this study are the five college environment measures.

The methodology being used in this study, then, does differ from the more "traditional" method of relating variables to extreme criterion groups, i.e., identifying under- and overachieving groups and then investigating how they differ. Instead, the moderated regression technique is a taxonomic approach to forming "natural groups" based on variables of interest and then determining the relationships between group membership and the within-group predictors-criterion relationship. It is suggested here that an approach using natural grouping should lead to results having greater generality. The formation of "natural" or representative groups with respect to a variable or variables of interest attempts to minimize the variation from one sample to another that is due to people sampling. The results based on the traditional approach of selecting groups at the extremes, with respect to some distribution on a criterion variable of interest, would seem to be far more susceptible to regression towards the mean. The possibility of increased regression effects towards the mean is, among other things, related to a lack of reliability in the measures and a lack of stability in the people sampling from one replication to the next. If fallible measures are used, and then the problem is further compounded by computing statistics based on two groups of individuals who by definition are not representative of the parent population, crossing these statistical estimates to another representative sample may indeed result in an extreme case of regression effects toward the true population means.

The Sample

A sample of 27 colleges was used in this study. These institutions were generally small (less than 1500 students) liberal arts colleges which might be expected to emphasize the educational outcomes measured by the GRE Area Tests. Thirteen of these were coeducational; the remainder were single sex institutions.

At each of the colleges, all available seniors or all members of a designated group, such as liberal arts majors, had taken the GRE Area Tests. Each of the colleges also required or recommended the SAT for admission.

A sample of 1064 students was randomly selected from among those seniors at the 27 colleges for whom SAT and GRE scores were available; there were 40 students from 24 of the colleges and slightly fewer from the remaining three. The sample of students within each college was randomly divided into two subsamples with one segment serving as a validation sample and the other for cross-validation purposes. The five mean college environmental scale scores for each college were assigned to students from that college.

The two random samples were analyzed independently by the moderated regression program for each of the three GRE Area Tests. The validation sample was first examined for the groupings with similar mean college environmental scale scores which also had large positive (overachievers) or negative (underachievers) mean residuals. The moderated regression technique was next applied to the cross-validation sample in an effort to see if the same groupings and their associated predictor-criterion residual relationships could be replicated. In effect, then, the cross-validation procedure confirms the extent to which residual values for two student groups within the same college are similar to each other; that is, the extent to which the within-college student samples were indeed randomly selected.

Results

Humanities

In Table 1, the mean residuals based on the regression of GRE Humanities on SAT-V and major field of study are presented for three groups of students

representing three groups of colleges. Because students from each college were assigned the college's mean environmental scores, groupings of students also represent clusters of colleges. The number of colleges in each group is indicated in parentheses. In those instances when only one college appears as a "group," no interpretation will be offered of the results based on the single college. The three groups were formed on the basis of the similarity of the college environment scores. The total sample was separated into only three groups in order to maintain sufficient within-group sample size. The size and sign of the group mean residuals indicate the relative under- or overachievement of the group.

Insert Table 1 about here

Two of the environmental variables, Curriculum Flexibility and Activism, did not yield consistent patterns of over- and underachievement in GRE Humanities. The other three variables, as indicated in Table 1, did result in consistent patterns. For example, colleges in Group 1 of the validation sample have the lowest mean Faculty-Student Interaction score (16.31) along with the largest negative mean residual (-15.51), indicating that they tend to be underachievers. Colleges in Group 3 had the highest mean Faculty-Student Interaction score (19.73) and a positive mean residual (10.01) indicating that students in these colleges tended to score higher on the GRE Humanities than one would have expected from the predictors used. Thus, students tended to overachieve at colleges with higher levels of Faculty-Student Interaction, while conversely students tended to underachieve at colleges with lower levels of Faculty-Student Interaction.

Colleges in Group 2, which had a relatively average level of Faculty-Student Interaction, did about as well on the GRE Humanities test as predicted. Inspection of the cross-validation sample indicates that the patterns for all three groups was completely replicated.

Similar results are found in Table 1 for the Cultural Facilities environment scale score. Students tended to underachieve in Humanities at colleges with fewer cultural facilities and to overachieve at colleges with more (or more highly rated) cultural facilities.

On the Unchallenging scale, low mean scale scores, which indicate a higher degree of challenge, were related to overachievement at five colleges. With only one college in the underachievement "group" (#1), few conclusions should be drawn about that relationship.

Natural Science

Presented in Table 2 are the GRE Natural Science mean residuals based on the regression of those test scores on SAT-V, SAT-M and major field of study. Once again three groups of colleges, each having similar mean environmental scores, were compared. Comparisons of the mean residuals and mean factor scores indicate that students tended to overachieve (i.e., have the highest positive residuals) at the 11 colleges with high scores on Faculty-Student Interaction (19.73), the 13 colleges with high scores on Curriculum Flexibility (14.52), and the six colleges with low scores on Cultural Facilities (10.19). Underachievement in the Natural Sciences was more typical at four institutions with low Faculty-Student Interaction and five institutions with high Cultural Facilities (all five were colleges for women). These results were replicated in the cross-validation samples.

Insert Table 2 about here

Social Science

Results based on the GRE Social Science Area Test are presented in Table 3. The pattern of residuals and mean factor scale scores indicate a tendency for students to overachieve on the GRE Social Science Area Test at colleges with high

Faculty-Student Interaction, although this result was not clearly cross-validated (Group 2 of the cross-validation sample had the largest mean positive residual but not the highest factor scale score). Students also overachieved at the 13 colleges with high Curriculum Flexibility, a result that may be noted for both the validation and the cross-validation samples.

Insert Table 3 about here

For the three remaining environmental variables, Unchallenging, Cultural Facilities, and Activism, consistent patterns of over- and underachievement in GRE Social Science were not found.

The results of this study must also be examined for possible artifactual effects. For example, the underachievers might consistently have significantly higher predictor scores and thus more likely regress towards lower means while conversely the overachievers might have extremely low predictor scores and thus regress on the criterion tests towards the higher total sample mean. Examination of the within-group predictor means suggested no consistent evidence with respect to either of these hypotheses.

The over- and underachieving groups were then examined to see if there was a tendency for the overachieving groups of each of the three GRE Area Tests to be characterized by a larger proportion of individuals indicating a major field of study in a related curriculum area while conversely underachieving groups might be characterized by having a larger proportion of individuals with majors in nonrelated subject areas. For example, the underachieving group on the Humanities test might include a large proportion of natural science or social science majors. Inspection of the data indicated a slight tendency for the overachieving group on the GRE Humanities Test to have more individuals majoring in humanities than did the underachieving groups. For the GRE Natural Science Test,

however, the tendency is reversed. That is, for the most part there were fewer individuals majoring in natural science in the overachieving group than in the underachieving group. For the Social Science Area Test there was no consistent pattern. Due to the lack of any overall significant trends little can be concluded in this study with respect to the impact of major area of study on over- and underachievement.

Discussion

To briefly summarize, the results of this study indicate that (1) Faculty-Student Interaction tended to be linearly related to achievement, in that students at colleges with high scores on this scale more often overachieved on the GRE Humanities and Natural Science Area Tests; in contrast, students underachieved on all three of the tests at colleges with low scores on this scale; (2) Curriculum Flexibility tended to be related to overachievement on the Natural Science and Social Science tests, with students at more flexible colleges overachieving; (3) students at colleges with high scores on Cultural Facilities overachieved on Humanities but underachieved on the Natural Science test; the five colleges where this occurred, however, were all colleges for women; (4) the Unchallenging scale was crucial in only the Humanities, with challenging colleges producing students who overachieved on this test; (5) Activism was not related to over- or underachievement on any of the tests.

While generalizations must be tempered by limitations of the sample of colleges and the criteria used in this study, the results do suggest that college environmental features are related to student achievement. Some of the results reinforce popularly held notions: in particular, that students learn more than might be expected if they feel that instructors are readily accessible, interested

in teaching, and interested in students as individuals. That this was true among a group of relatively small colleges does, moreover, belie the belief that all small colleges have meaningful faculty-student interaction; while the faculty-student ratios may be similar, there are distinct differences in the degree to which faculty and students interact, and this in turn is related to achievement.

Also related to overachievement were college environments in which students perceived freedom in choosing courses and could try out a variety of courses before selecting a major. Several explanations might be offered for this result. One possibility is that students are more motivated to learn in courses of their own choosing, an explanation that, if valid, would certainly lend support to recent efforts to relax undergraduate curriculum requirements. Another explanation, however, is that colleges with a more rigid curriculum attract less motivated students and faculty. That a more flexible curriculum would in turn attract more able or motivated faculty and students is, it seems, a plausible hypothesis.

High scores on the "Cultural Facilities" factor which indicate excellent facilities in music and art, as well as what students view as a rich cultural program, were related to overachievement in the Humanities but underachievement in the Natural Science tests. This pattern was found at five colleges in the sample, all of which were women's colleges. To some extent the added interest that women generally have in the Humanities as compared to the Natural Sciences may account for this pattern (see, for example, Katz, Norris, & Halpern, 1970), although with major field controlled such effects should be minimized. A more significant reason may be the emphasis in the Humanities and the de-emphasis in the Natural Sciences among certain women's colleges; this emphasis is indicated in the facilities, in the curriculum, and in the extracurricular program. Indeed Nichols (1964) similarly found that students at a small sample of women's colleges had higher senior

GRE-Verbal scores but lower GRE-Quantitative scores than predicted from their freshman aptitude scores.

Colleges where students experienced challenge in their course work were also those at which students overachieved in Humanities (this group included co-educational institutions). Why the degree of challenge should be particularly crucial for achievement in the Humanities is not immediately discernible. One explanation would be based on considering items in the scale which ask students to rate the college library and available bookstores. Because the Humanities may be less "curriculum based" than the Social Sciences or the Natural Sciences--that is to say that humanities courses more frequently require students to read widely and rely less on a textbook--having excellent libraries and bookstores may be especially crucial to achievement in that area. Moreover, students may view extensive reading assignments (and voluntary reading) as "challenge" in a course.

The fifth environmental scale, Activism, which measures the degree of (perceived) student concern about controversial issues (political, social, or economic), was not related to over- or underachievement in any of the subject areas. While there was no reason to expect that student activism would be related to over-achievement, critics of student involvement in political activity have argued that such activity would result in students achieving less than they should in traditional areas of learning. For this group of colleges and at the time of this study, this fear was not justified.

In conclusion, the results of this study indicate that certain selected college environmental features were related to students achieving more or less than one would predict from their aptitude at entrance. Some of these environmental features, furthermore, appear to be ones over which colleges have some control. Because of the limited number of colleges available for this study, replication with another group of colleges would be desirable.

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Table 1

GRE Humanities Mean Residuals and Group Means on
Selected College Environmental Scales
for Validation and Cross-Validation Samples

	Validation			Cross-Validation		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
			Faculty-Student Interaction			
N Students (Colleges)	79 (4)	242 (12)	211 (11)	80 (4)	240 (12)	212 (11)
Mean Faculty-Student Interaction Factor Scale Scores	16.31	17.85	19.73	16.31	17.86	19.73
Mean GRE Humanities Residuals	-15.51	-3.66	10.01	-16.07	-2.15	8.50
			Unchallenging			
N Students (Colleges)	21 (1)	410 (21)	101 (5)	21 (1)	409 (21)	102 (5)
Mean Unchallenging Factor Scale Scores	20.15	17.65	14.96	20.15	17.65	14.96
Mean GRE Humanities Residuals	-39.09	-2.00	16.24	-20.88	-2.28	13.46
			Cultural Facilities			
N Students (Colleges)	123 (6)	309 (16)	100 (5)	121 (6)	310 (16)	101 (5)
Mean GRE Cultural Facilities Factor Scale Scores	10.19	12.06	13.98	10.18	12.05	13.98
Mean GRE Humanities Residuals	-14.10	2.42	9.88	-13.42	3.45	5.50

Table 2

GRE Natural Science Mean Residuals and Group Means on Selected College Environmental Scales for Validation and Cross-Validation Samples

	Validation			Cross-Validation		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
			Faculty-Student Interaction			
N Students (Colleges)	79 (4)	242 (12)	211 (11)	80 (4)	240 (12)	212 (11)
Mean Faculty-Student Interaction Factor Scale Scores	16.31	17.85	19.73	16.31	17.86	19.73
Mean GRE Natural Science Residuals	-14.84	-.50	6.13	-11.55	-2.17	6.82
			Curriculum Flexibility			
N Students (Colleges)	20 (1)	260 (13)	252 (13)	20 (1)	262 (13)	250 (13)
Mean Curriculum Flexibility Factor Scale Scores	8.02	11.18	14.52	8.02	11.18	14.53
Mean GRE Natural Science Residuals	-33.10	-11.82	14.82	-42.71	-6.59	10.32
			Cultural Facilities			
N Students (Colleges)	123 (6)	309 (16)	100 (5)	121 (6)	310 (16)	101 (5)
Mean GRE Cultural Facilities Factor Scale Scores	10.19	12.06	13.98	10.18	12.05	13.98
Mean GRE Natural Science Residuals	18.61	-2.63	-14.75	14.25	-2.82	-8.40

Table 3

GRE Social Science Mean Residuals and Group Means on Selected College Environmental Scales for Validation and Cross-Validation Samples

	Validation			Cross-Validation		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
			Faculty-Student Interaction			
N Students (Colleges)	79 (4)	242 (12)	211 (11)	80 (4)	240 (12)	212 (11)
Mean Faculty-Student Interaction Factor Scale Scores	16.31	17.85	19.73	16.31	17.86	19.73
Mean GRE Social Science Residuals	-14.41	-2.98	8.81	-6.19	1.82	.28
			Curriculum Flexibility			
N Students (Colleges)	20 (1)	260 (13)	252 (13)	20 (1)	262 (13)	250 (13)
Mean Curriculum Flexibility Factor Scale Scores	8.02	11.18	14.53	8.02	11.18	14.53
Mean GRE Social Science Residuals	-16.58	-17.90	19.79	-27.38	-9.50	12.15